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THE STRUCTURE OF JAVANESE *PERAHUS*

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ABSTRACT

The construction of a number of Javanese *perahu* types is described. A consistent four-strake structure is noted. A variety of bow and stern structures are described in which the stem and sternpost are either absent or structurally superficial. Structural affinity with ancient sewn plank designs is suggested.

KEYWORDS: Java, Indonesia, maritime archaeology, boat building, perahu.

INTRODUCTION

This paper presents lines, plans and construction details of three vessels from the Javanese tradition and a Malaysian vessel of similar construction. Typical features of the predominant Javanese *perahu* type - the *mayang* are described. Other Javanese and Madurese types are surveyed giving detail of some unusual stem and stern structures. The large, fully enclosed cargo carrying *perahu* of Madura are not included in the scope of this paper, nor is it intended as a comprehensive survey of Javanese and Madurese open boats.

The maritime traditions of Java and the large off-lying island Madura are part of the overall Southeast Asian maritime tradition but they can be treated as a distinct group of traditions (Macknight 1980:22).

The Madurese component is an important distinguishable element of this group and in considering the construction of traditional vessels some Madurese types show significantly different structure from the traditional types of Java.

The names of *perahu* types and Javanese nautical terms used here were mostly collected during a visit to Java in March, 1989. Translations and explanations of the terms were provided by local Javanese people and confirmed by rechecking later with other Javanese people of the same area. Very few of these words, nautical or otherwise, appear in the Javanese/English dictionary available to me (Horne 1974).

THE *MAYANG* TYPE *PERAHU*

The predominant *perahu* type of Java can be identified as the *perahu mayang* or "mayang type" (Horridge 1981:47-50, 82). Properly the name *mayang* belongs only to fishing vessels which are equipped with *payang* (purse-seine) nets but the term can usefully be extended to include all Javanese *perahu* with similar lines and construction to the traditional *payang* equipped *perahu mayang*. According to Horridge (1981:47) the *mayang* hull is characterised as "flat-bottomed with a large (sometimes very large) flat stem". They are not actually flat-bottomed in the strict technical sense that a barge is, but they have little or no deadrise in the midsection. The midsection is very distinctive and provides the principal distinguishing characteristic used in this paper. Typically there are four broad flat strakes forming a section with three chines. This feature can be seen in the lines of the vessels *Terima Kasih* and *Perawan* (Figs 1, 3, 7).

Another characteristic of the *mayang* type is the use of bulkheads rather than ribs (Horridge 1981:49). Not all *mayang* type are now built with bulkheads but bulkheads can be seen in the construction plans of *Terima Kasih* and *Perawan* (Figs 2, 4, 7). The bulkheads are luted and paid with resin as if to make them water-tight but there are limbers (holes)

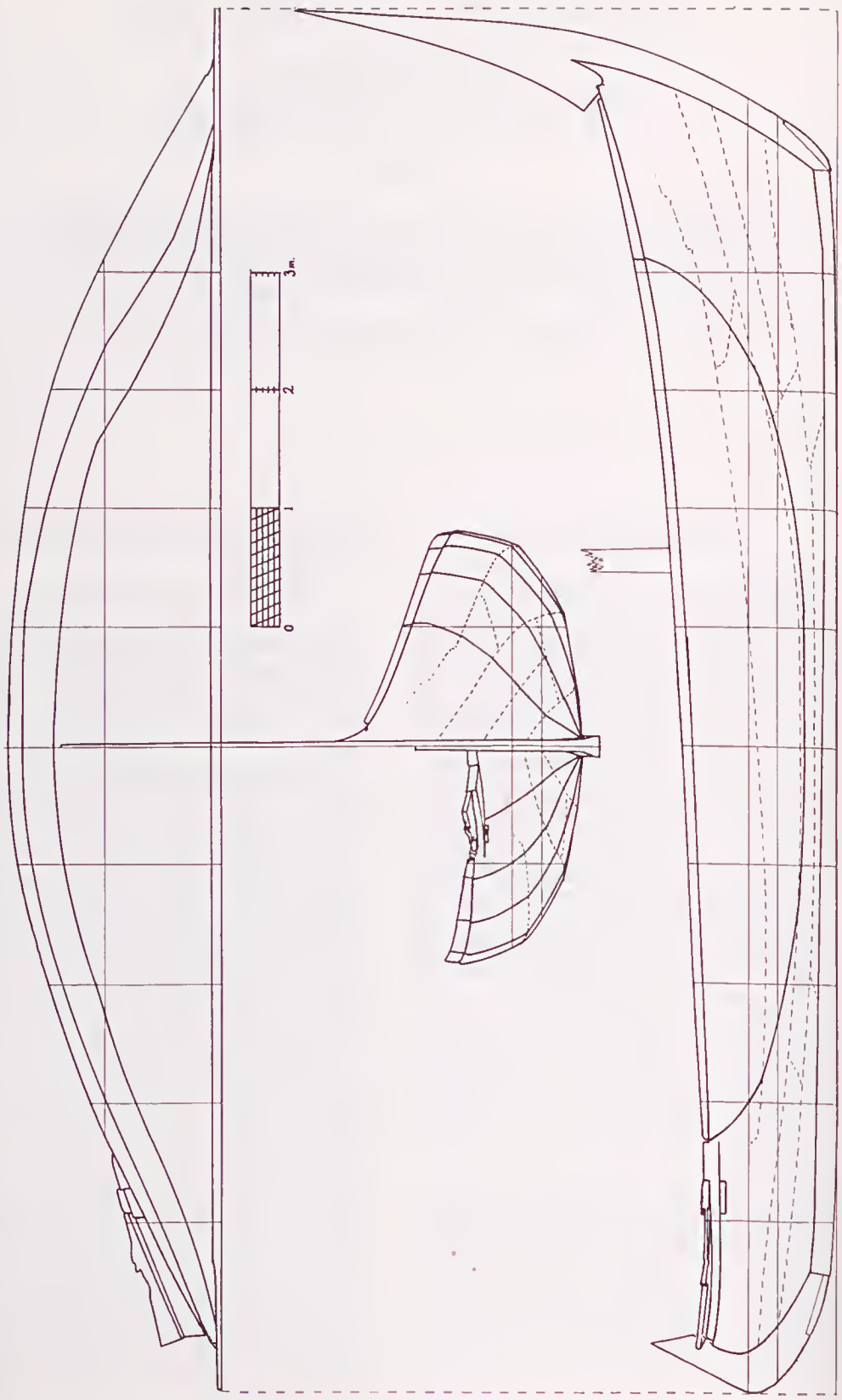


Fig. 1. Lines of *Terima Kasih*.

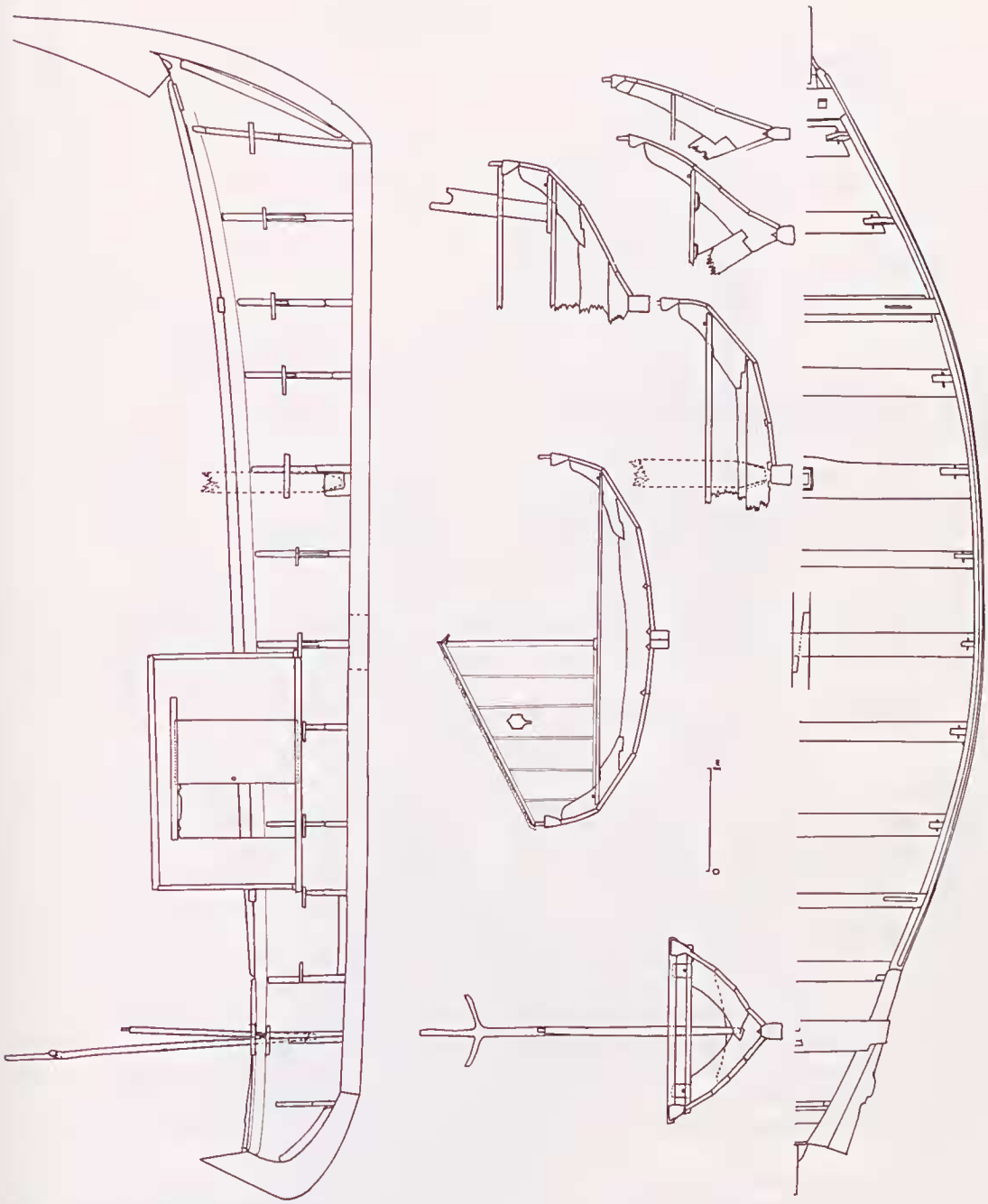


Fig. 2. *Terima Kasih*, construction diagram.

through the bulkheads to allow passage of bilgewater along the keel and first chine. Luting rather than caulking is used in the Javanese tradition; fibrous material, usually paper bark (*Melaleuca* sp.) is placed into the seams between timbers during assembly whereas caulking is served (hammered) into the seams after assembly.

Some *mayang* type vessels have stems which form large projecting prows and there are often similarly projecting stern posts. These form the distinctive prow shapes which identify many of the *mayang* types found along the Java coast (Horridge 1986:10-14). Some types have only small stems and sternposts and there are also vessels with the typical

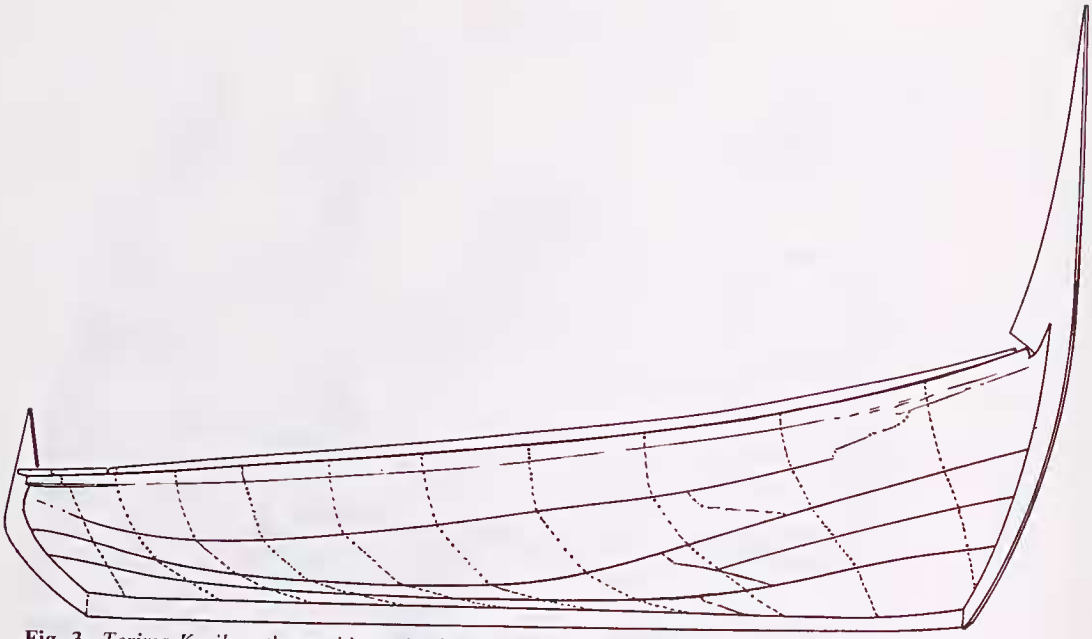


Fig. 3. *Terima Kasih*, orthographic projection showing run of straiks.

mayang midsection which have no stem or stern post; the planking simply meets at the ends of the hull (Fig. 8).

CONSTRUCTION OF JAVANESE *PERAHU*

There are a number of peculiar bow and stern structures used in the construction of the *perahus* and small craft of Java and Madura. In the following descriptions of these structures, where only a bow structure is detailed, it may be assumed that the stern structure is the same. There is a considerable range of sophistication in the boat building found along the coast of Java. At Jepara there are simple rafts formed of three logs dowelled together. Simple dugout canoes can be found in a number of places but in recent years availability of suitable logs for dugouts has been very restricted.

Planked-up dugouts are more common. Along much of the north coast of Java there is a more-or-less standard form for planked-up dugouts, although structure varies regionally. Like all Indonesian planked vessels they are shell constructed with edge-dowels holding the planks together. Characteristically these planked-up dugouts have absolutely straight flat sides through a long midsection. The bow and stern are moulded to meet the flat sides at an angle (Figs 9, 10), rather than curve gently into the midsection. Some traditional vessels from other parts of Indonesia have a similar hard angle at the bow and stern but the flat sides of the Javanese canoes seem to be unique (cf. Horridge 1979b:Figs 8, 9, 33; Burningham 1988:Figs 3, 7).

The structure of the planked-up canoes of Central Java is crude. The hard angle in the bow and the stern are formed where flat planks are butted together (Fig. 9). There is a stem-like structure made up of a number of horizontally layered blocks. The planks that form the bow and stern simply butt on to the stem piece and are each secured to the stem by a single skewed dowel. These vessels usually have a relatively large and heavy dugout base. They are normally fitted with a single outrigger carried to port on a single boom (Fig. 11). The best examples of this type are the *jukung* of Rembang, close to the border of East Java (Hawkins 1982:101-103).

In East Java, mainly in the area of Tuban, there are planked-up dugouts with similar hull form but more sophisticated construction (Figs 10, 12, 13). These are called *jatan* or *jatan walon* if they have a true dugout base. However there are many of the same hull form which have the dugout base reduced to a central plank or even a narrow keel, in which case they are called *jatan pedatan*; this apparently means *jatan* [i.e. dugout] that is not [a dugout].

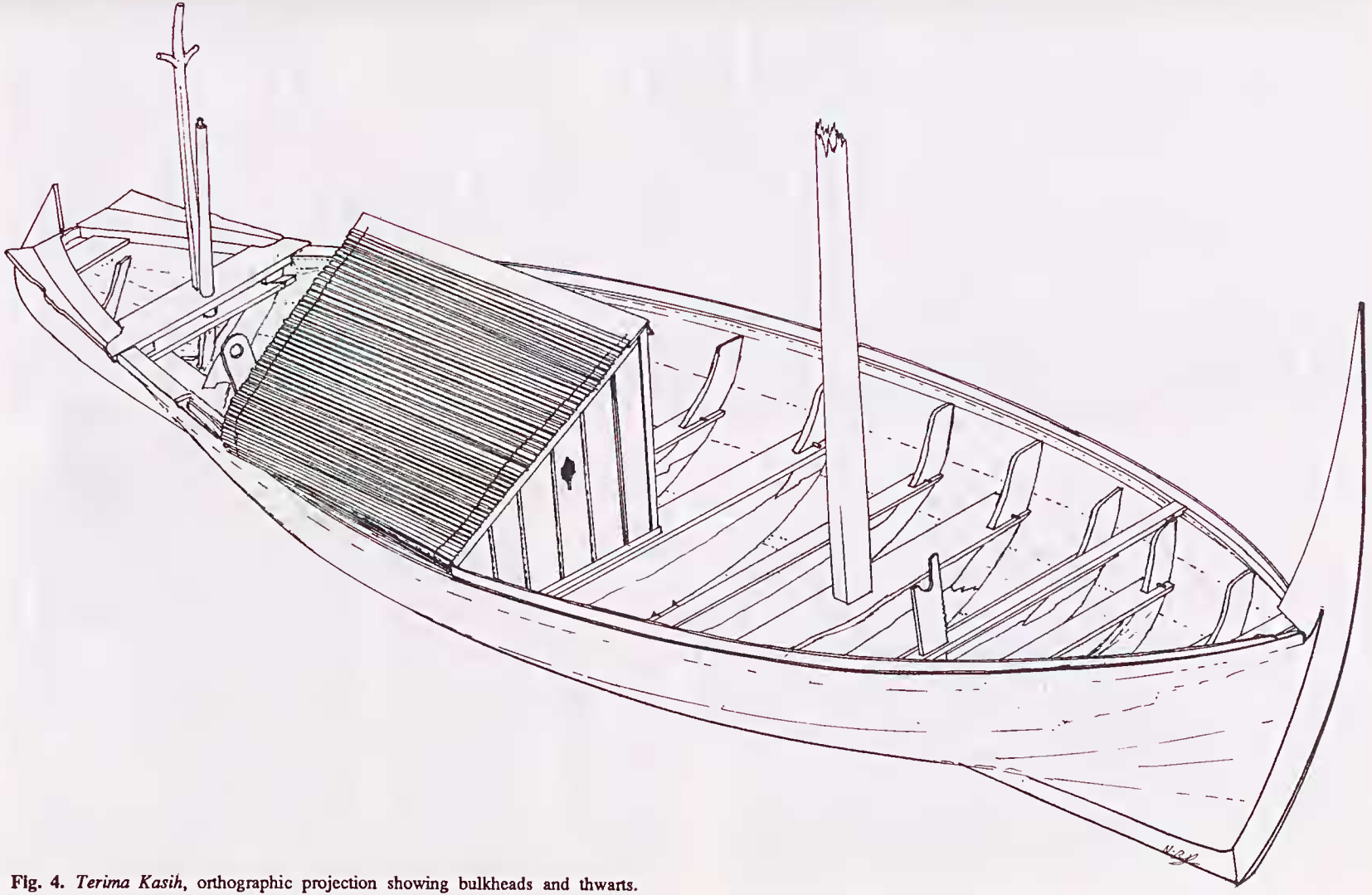


Fig. 4. *Terima Kasih*, orthographic projection showing bulkheads and thwarts.

The structure shown in Figures 10, 12 and 13, is fairly typieal for *jatan pedatan* but not all have the forked or wing stem-pieces. Some have the simple bloek stem-pieees found in central Java but the stem is raked so that the plank ends ean be edge-dowelled to it (Fig. 14). The dowels whieh hold the planks together are all fitted with locking pins (Fig. 15).

Typically the turn of the bilge is carved into the plank which forms the lower part of the topsides. This plank is called *papan menteng* (*papan*=plank, *menteng*=paunch). There are never any ribs. A number of thwarts and beams (usually six) are fitted. Small thwarts let through the hull help to hold the ends together.

Like the *jukung* of Rembang the *jatan* earry a small sprit rig but they are not fitted with outriggers to provide stability so their hull form is relatively wider and lower.

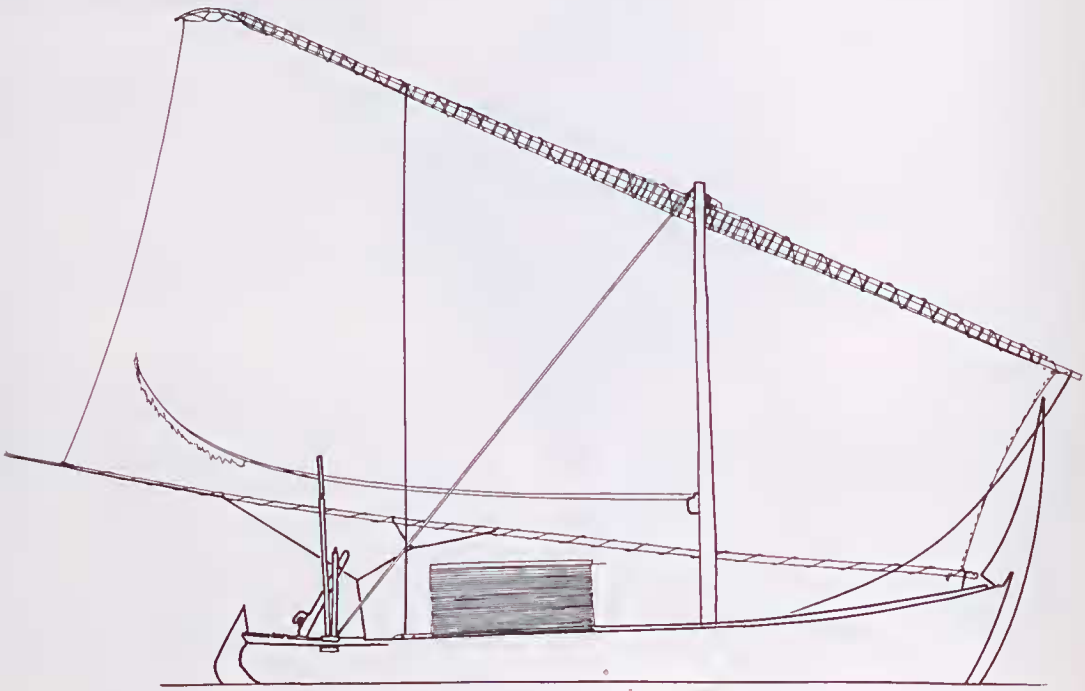
On Madura and the Java coast near Madura there are built-up dugouts belonging to the Madurese *Jukung* tradition. Their strueture belongs to a very widely spread tradition ealled the "five part canoe" by Haddon and Hornell (1938:5) (see also Horridge 1987).

PLANKED BOATS

Stemless boats called *perahu jegongan* and *perahu condong* are found in the Indramayu area of West Java. The *condong* is a rare form of *jegongan* with a split prow (Fig. 16). *Jegongan* have the typieal four-straik strueture of *perahu mayang*. The planking simply meets at the bow and stern where it is held together by tree-nails (dowels) and it is also fastened to an apron-like pieee *(serang)*. The *serang* is fitted after the planking is assembled, it is often shaped from a split tree trunk and is left fairly roughly shaped near the top (Fig. 25a). The prow and stern finials also have apron-like pieces inserted, these are separate from the *serang*. In the bow there is a small thwart let through the planking. In both bow and stern there are frames formed from grown forked timbers called *gading cempet* (pinehed or squeezed frames). The ends of the *gading cempet* projeet above the rail forming bollards or bitts in the bow.

Although *jegongan* have the distinctive *mayang* four-straik shape they are frequently built with a greater number of straiks because of diffieulty in aequiring suitably wide planks: Even so, the builders shape the vessels with three ehines and eonsider the vessels to have four straiks or *jegong*. The four straiks are named *jegong dasar* (base straik), *jegong karon* (*karon* is riee cooking but not yet rising), *jegong telon* (third straik) and *jegong menteng* (paunch straik).

Fig. 5. *Terima Kasih*, sail plan.



A moderately large *jegongan* at Eretan west of Indramayu measured 10.6 x 3.8 x 1.15m. This eompares with typieal large *mayang* measurements of 11-12 x 3.65 x 1.15m given by Horridge (1986:10). The *jegongan* has relatively greater beam but thc immersed hull form is similar because the water-line length is the same as the overall length in the ease of the *jegongan* which has plumb (vertical) ends.

At Eretan and nearby Parian there are many *jegongan* but the most numerous *perahu* there is another type with the *mayang* mid-section callcd *perahu compreng*. There arc many *compreng* of the same size as the large *jegongan*, but the *compreng* are used only for fishing in local waters, whereas *jegongan* voyage farther and ean be found along the Central Java coast, even during the west monsoon when heavy weather is most likely (pers. obs. Mareh 1989). Most *jegongan* are now fitted with long shaft motors and earry a small auxilliary *lete* type sail (Fig. 29). Formerly they earried quadrilateral sails similar to that illustrated in Figure 5.

Perahu Kompreng, Compreng or ***Sompreng*** are *mayang* type vessels built and operated on the coast of west Java around Cirebon and Indramayu, and in the western part of central Java. They have high curved prows that give a charaeteristie *mayang* profile (Fig. 17), and they have the four-straik structure and form although there are frequently more straiks used if wide planks are not available. In the following deseription of the structurc and illustrations a "elassical" four-straik structure is assumed.

The bow is constructed with a stem which is mortieed on to the end of the keel. The lower three straiks are fastened into a rabbctt on the stem. The fourth straik terminates a little abaft the stem. The prow is built up from bloeks of timbcr tenoned together whieh radiate from the forward ends of the fourth straik (Fig. 18). Perhaps this peculiar strueture was once more clegantly moulded using selected grown eurved timbers in a strueture similar to the *jatan's* bow (Fig. 19). *Kompreng* are now built from straight planks and bloeks bought from saw mills.

The stern strueture is similar but there is only a very short stern post formed by an upturned end of the keel (Fig. 20). Only the first straik terminates on the stern post. The seeond and third straiks run out as stealers in

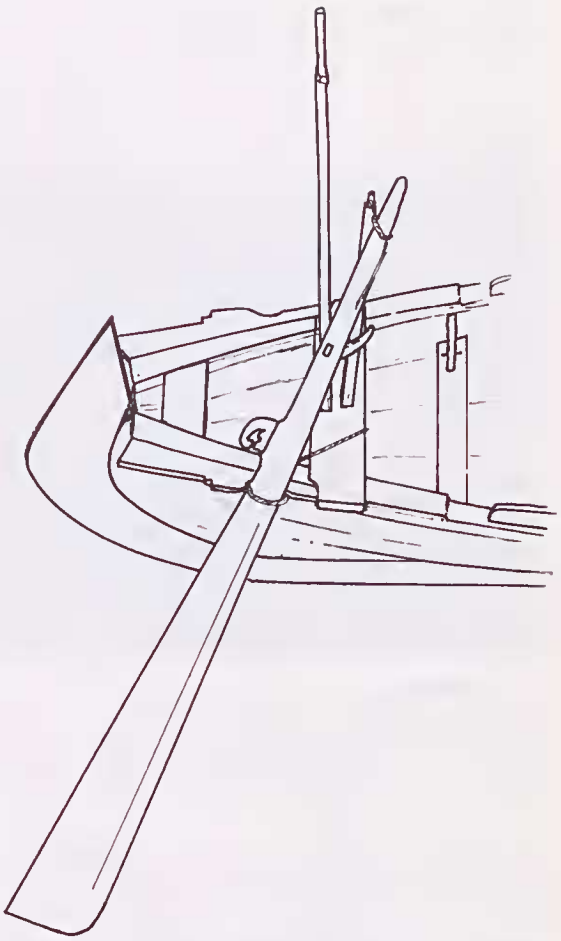


Fig. 6. *Terima Kasih*, orthographic projection showing rudder mounting.

the first straik and second straik respeetively. The fourth straik is moulded into the stern finial in the same way that it is moulded into the prow. Some small *kompreng* have the stern finial built up from forked timbers, perhaps this was onee standard both in the bow and stern.

The pieees that are tenoned together to form the sternpost and stern finial strueture are fitted after the planking is in plaee, and an apron-like piece has been fitted (Fig. 21).

Perahu kompreng earry a three spritsail rig when reaehing or sailing to windward. When sailing off the wind the mizzen is unstepped. The large Javanese rudder carried on the lee side (Fig. 6) eonfers resistanee to leeway, whieh the hull laeks, only if there is suffieient sail area aft to prevent lee helm; henee the use of the mizzen (ef. Horridge 1981:Pl. 24).

Perahu Seroto are built in the same area as *perahu kompreng*, that is mainly around Cire-

Fig. 7. *Perawan*, lines and construction.

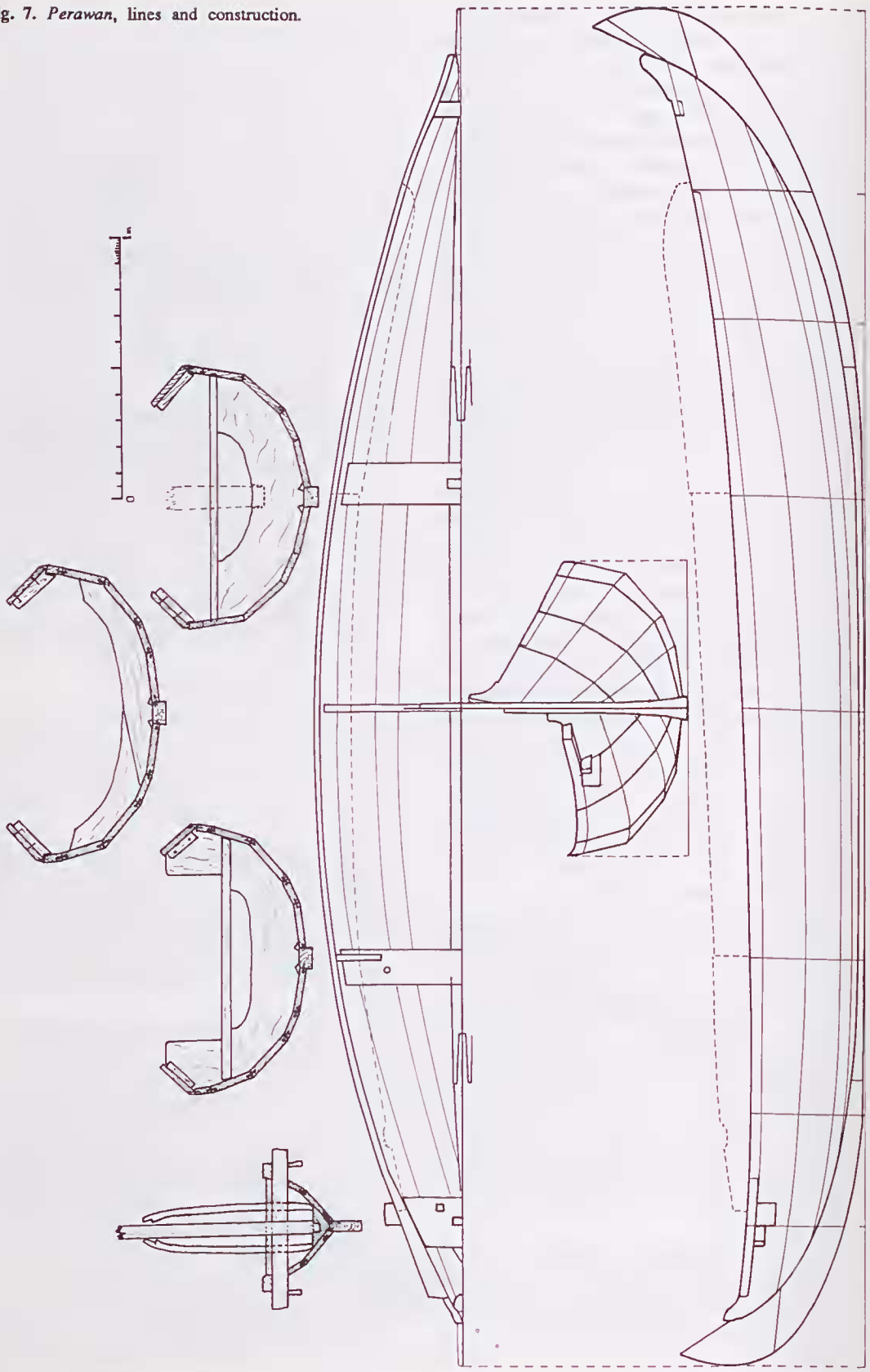


Fig. 8. *Perahu jegongan.*

bon. They carry the same three spritsail rig. Most *seroto* are the size of the smallest *kompreng* (about 5-6m) but a few larger derelict *seroto* could still be seen on the banks of the river west of Cirebon in March 1989. The *seroto* have a stem and stern post but the planking is not always fastened to a rabbett on the stem or stern post. The structure is rather like the simple built-up dugout where the stem butts on to the ends of the planking. There are presumably dowels securing the plank ends to the stem. There is an apron in the *seroto*. The high prow and stern finial are formed partly by the stem or stern post and partly by converging planking. It looks much like a stemless structure. Hawkins (1982:98) shows a *seroto* stern.

The *Perahu Pencoan*. of Waru, East Java has bow and stern profile similar to the *seroto*, although the structure is slightly different (Fig. 22). Waru is a large coastal village about 15km east of Brondong in the *kabupaten* of Lamongan. The *perahu penco* or *pencoan* built at Waru are found in many places along the Java coast at least as far west as Tegal and often they are called *perahu waruan*. They are built with the ends of the planking fastened to a broad stem that projects very little (or occasionally not at all) forward of the planking. Formerly there were large cargo carrying *pencoan* rigged and decorated like Madurese *Golekan* (Fig. 23; Horridge 1981:42-43). Some small *pencoan* have a four-straik form and structure but the majority do not. In some cases the keel projects slightly at the bow and stem.

Small *Perahu* of Central Java. There are, few if any, large traditional vessels built in Central Java. Large *mayang* type *perahu* are purchased from West Java and East Java,

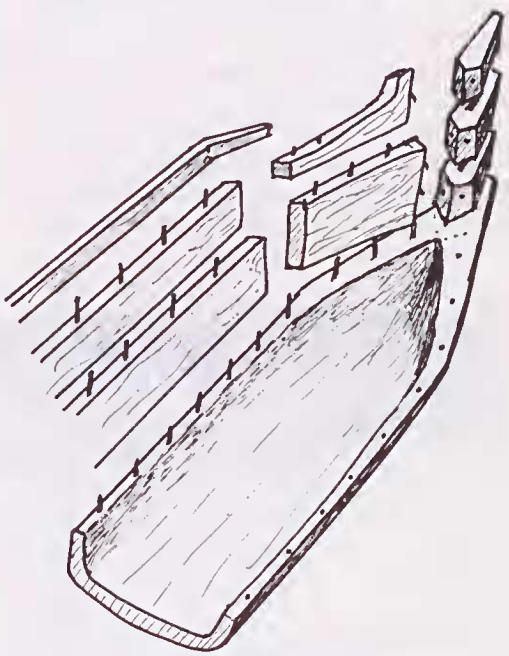


Fig. 9. Structure of Central Java built-up dugout canoe.

Fig. 10. Bow of East Java *jatan*.

especially from Brondong and Blimbing. There are slightly smaller plain double-ended vessels built in Central Java, some with *mayang* midsection. These are called *kolek* or *sopek*, or known by more particular local names such as *perahu pekem* and *coklet*, which distinguish local variations in prow style or in hull form.

Perahu sopek of the large promontory between Semarang and Juwana have a distinctive style. There is considerable range of size: small *sopek* are lightly constructed and have little beam. The *sekoci* from Trengganu Malaysia are very similar in shape and structure. The lines of a small *sekoci* brought to Darwin in 1978 as a yacht's tender are presented in Figure 24. The *sekoci* is a type which has been replacing the more traditional and elaborately decorated fishing *perahu* on the East coast of Malaysia since world war II (Gibson-Hill 1954:149). It was presumably introduced from Indonesia since the name is an Indonesian corruption of the Dutch *schuitje* (Gibson-Hill 1950:132).

The best of the larger *sopek* are robust, well built craft with greater beam and a clear four-straik structure. Most of these *sopek* are constructed with a rabbett on the stem and sternpost and with aprons fitted in both bow and stern. On the larger vessels the top of the apron projects above the line of the sheer and forms a small finial (Fig. 25). Similar finials are found on many Javanese *perahu* built further east and there are similar finials on the stemless *perahu jegongan*.

The *perahu pekem* (Fig. 26) is built in the same area as the above mentioned *sopek*, around Jepara. It has a deep and beamy hull and a different structure. The keel is small and hardly projects below the garboard straiks; it is little more than a plank midships. The planks meet in the ends and they are fastened

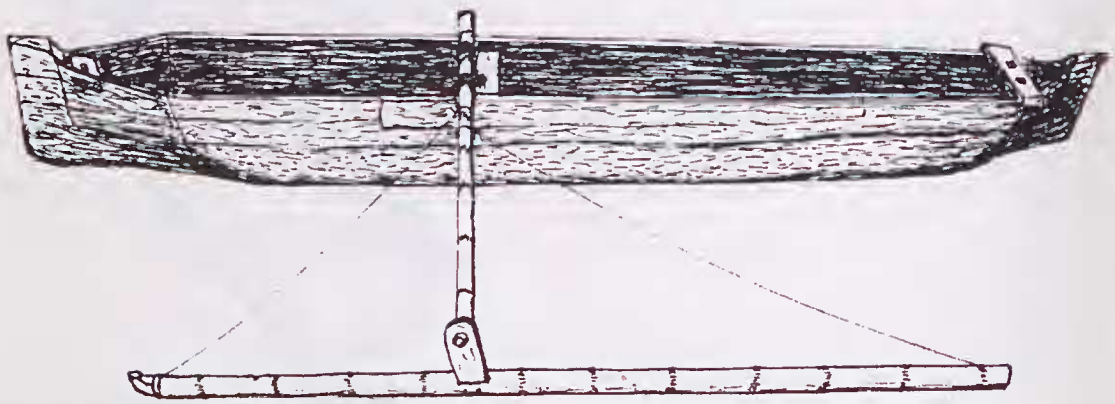


Fig. 11. Outrigger of Central Java canoe

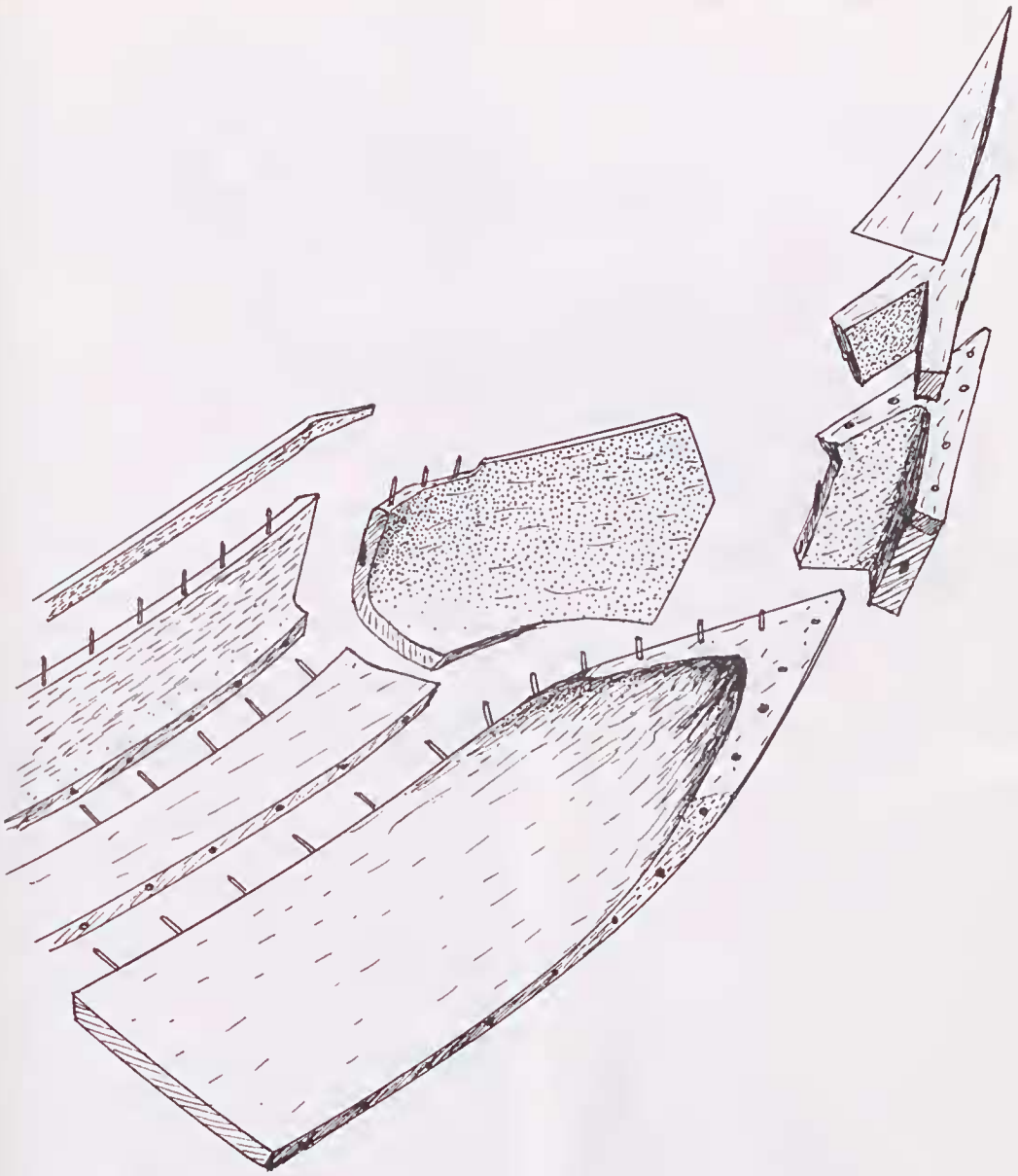


Fig. 12. Structure of East Java *jatan* bow.

to an apron, there is a stem but the plank-ends simply butt on to the aft face of the stem. On a derelict *pekem* at Jepara I could find no fastening of the planks to the stem, but the stem was fastened to the apron. Formerly large *pekem* were used as cargo carrying boats according to an informant at Jepara.

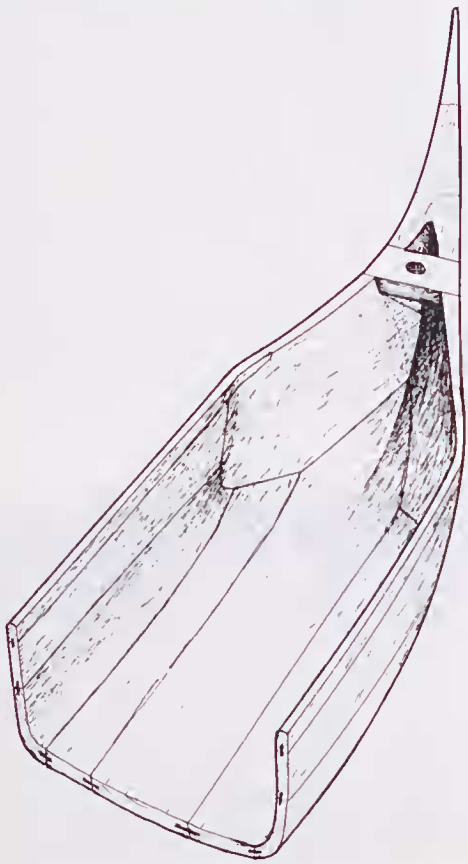
***Perahus* of Brondong and Blimbing.** Many of the *mayang* type vessels found on the Java coast were built in the twin villages of Brondong and Blimbing in the *kabupaten* of Lamongan in East Java. The two main types built at Blimbing/Brondong are usually called *konteng* and *jong* or *ijon* by the people there, but they are often given other names when they are owned and operated elsewhere. For instance, *Terima Kasih* (Figs 1-6) was built as a *konteng* at Blimbing but she was a *perahu beranjang* at Jepara where she was owned. A large fleet of Blimbing-built *jong* operated from Rembang are apparently called *Konting*

there (Horridge 1986:13; Hawkins 1982:104-5).

Both *konteng* and *jong* have four-straik construction. *Konteng* are larger: *Terima Kasih's* dimensions are typical: 11.675 x 3.650 x 1.150m. Nearly all *konteng* are built this size. Scaled down versions are sometimes built to order.

Terima Kasih, now in the collection of the Northern Territory Museum, is a *konteng* which was taken to Jepara, Central Java and fitted with *anjang* fishing gear which made her a *perahu beranjang*. *Anjang* are two long booms which can be rigged out to port to spread a net horizontally in the water. At night pressure kerosene lamps suspended over the net attract fish and squid which are caught when the net is winched up. *Beranjang* operate out of Jepara especially around Karimun Jawa islands. The same fishing technique is used in other areas with nets spread from stationary platforms (*bagan*), large outriggers (*bagan satu*) and large catamarans (*bagan dua*). *Beranjang* cannot spread such large nets as *bagan* but they are more suitable for making a passage in a seaway.

Fig. 13. East Java *jatan* bow, internal view.



Terima Kasih has a small cabin built on her starboard side leaving the port side clear for handling the nets and *anjang*. *Konteng* at Blimbing usually have no cabin while *konteng* used for cargo carrying have large cabins formed by roofing over most of the hold (Fig. 27). Cargo carrying *konteng* are operated from Sedayu Lawas near Blimbing and were formerly operated from Karimun Jawa.

The construction of *Terima Kasih* provides a good example of *mayang* type construction. The *konteng* of Blimbing are built to a formula, there are no plans or written table of dimensions but the size of each of the four straiks is fixed. A full size *konteng* has thirteen frames, whereas a full size *jong* has ten frames. In *Terima Kasih* ten of the frames are constructed as bulkheads. Forward there are two heavy frames which almost form bulkheads and aft there is one smaller grown frame. *Konteng* under construction at Blimbing in March 1989 all had thirteen bulkheads. These bulkheads are not built-up to the level of the rail. At about the level of the third chine the bulkheads support large thwarts. Top futtocks or top pieces (*toplet* or *taju)* set into the bulkheads project through the thwarts and support the fourth straik. They do not support the heavy rail timbers *(golak* or *gotek)* which are edge-dowelled on to cap the planking. Above the *golak* there is a low wash straik.

All the planks are edge-dowelled together with 12mm diameter dowels set at 75mm centres, they are all locked by locking pins. In recent years this practice has changed: now four of every five dowels are replaced by mild steel pins. The dowels are usually *kayu pung* (*Dichrostachys cinerea*). The planking and all other timbers are teak *(Tectona grandis)*. The four straiks are very wide; the third straik is 720mm wide and only 25mm thick at the midsection. Such wide planks would be very likely to start (loosen) the caulking or luting and break the edge-dowels by expanding and contracting if they were not high quality teak, which expands and contracts very little in response to changes in ambient moisture.

The planks are long but do not run the full length of straiks. The butts are tapered (diagonal to the run of the straiks), and they are arranged to lie where there is most curve or twist in the straiks so that the need to bend

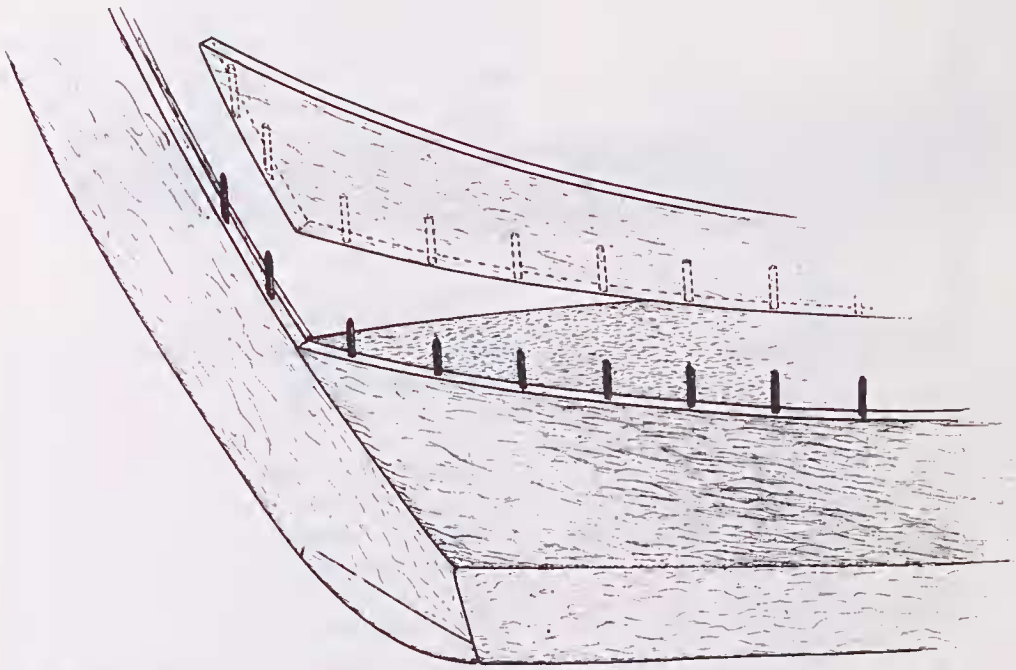


Fig. 14. Edge-dowelled plank fastened to aft face of the stem by dowels.

planks is minimised. The run of the straiks and position of the butts is indicated on the sheer plan (Figs 1, 3).

There is no rabbett on the stem. The forward ends of the planks meet where they butt onto the aft face of the stem; the plank ends are dowelled to the stem (Fig. 14). The stem is also secured to an apron but this apron was fitted at Jepara by Central Javanese boat builders. Aprons are unknown in *perahu konteng* at Blimbing.

The keel is two lengths of timber scarfed midships, however in many *konteng* the keel is a single timber, and in recently built vessels it is a much more substantial timber. There are keel bolts fastening the bulkheads and frames to the keel. The bulkheads show a variety of structures, some are frames composed of floors and top pieces with lighter planking fitted to complete the bulkhead to the level of the thwart. Others are composed of heavy timbers layered horizontally. The structure of selected bulkheads is indicated on the construction plan (Fig. 2).

The mast is stepped through a large thwart into a large thwartship mast step timber, which is a floor fitted immediately abaft of the bulkhead. The mast heel is tapered so that it wedges into the aperture in the step and does not touch the keel. The only standing rigging is a single backstay leading well aft so there is little downward force on the mast.

The two thwarts *(dapuran)* in the stern which step the rudder mounting post and the large boom crutch are let through the hull planking. They project slightly like the rudder mounting beams *(sangkilang)* of traditional South Sulawesi *perahu* (cf. Horridge 1979: Fig. 18) but the rudder is not secured against these beams so the projection is functionally redundant. The crutch which is stepped through the *dapuran* would take considerable load when bearing the weight of the spars, sails and drying nets if the vessel was rolling. It has been suggested that the crutch also supports the mast through a "bar" (*andang*) connecting the mast to the crutch (Horridge 1981:47). This is the not the case on *Terima Kasih* nor is the *andang* strong enough to effectively stay the mast on any *mayang* that I have had the opportunity to inspect.

The rudder mounting system (Fig. 6) is typical for Javanese vessels. The enormous rudder is always carried on the lee side and must be shifted around the stern when the vessel wears on to the other tack. The loom or stock of the rudder is heavy enough to counterbalance the blade of the rudder so that the rudder can also be used as an oar if the head of the stock is unshipped from the mounting post.

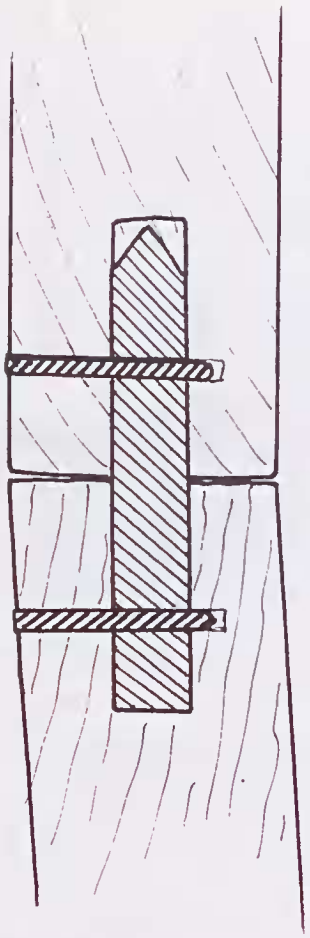


Fig. 15. Section through edge-dowelled planking showing locking pins.

There is no fixed deck but there are permanent fore and aft timbers between the thwarts along the centre line. These are fitted on most *mayang* type vessels. At Blimbing they are called *sendeng* while at Indramayu they are *sentang*. No bilge pump was fitted on *Terima Kasih*. Water was removed from the bilge by bailing. The planking in the bilge has been abraded by bailing to such an extent that the edge-dowels between the planks have been exposed in places.

The rig (Fig. 5) with the large quadrilateral sail was once standard on *perahu konteng*. It is still used at Jepara (pers. obs. March 1989) but in East Java the *lete* rig (Fig. 29) is now standard. The upper spar is built of laminations and battens of teak held together by thousands of siezings of monofilament nylon fishing line. The spar is formed with the aft end very tapered and curved.

Terima Kasih was purchased at Jepara by Jamie Munro and the late Jerry Williams in 1982. They sailed her to Darwin with no other crew. She was at that time fairly old and leaked, especially around the forefoot where some fastenings and dowels had failed.

At Darwin she was sailed in company with some Indonesian *perahu lambo* which are sailed there as yachts. She was not as fast, nor as weatherly as the *lambo* in spite of her fairly generous sail plan.

Perahu Jong* or *Ijon of Blimbing (Fig. 28; Hawkins 1982:104-5) are smaller and slightly less heavily built than the *konteng*. At full size they are 9 x 3.3 x 1.15m, the lines are similar but tend to be slightly fuller. They are very popular fishing boats and can be found in many places along the Java coast, known by various local names such as *ganibu* and *coklet*, but they always originate from Blimbing.

The structure is similar to that of the *konteng*; the planking meets at the ends and is edge-dowelled to the inboard faces of the stem and stern post. Immediately aft of the prow there is a second prow finial formed by the conjoined ends of the rail and an apron-like piece (Fig. 25). This is similar to the structure noted on the Central Java *sopek* but in the case of the *jong* the apron piece is short. It does not extend below the fourth straik.

In the bow and stern there are thwarts dovetailed into the rail which help tie the ends together. It is the practice of the builders to set up turnbuckles or a spanish windlass to pull the ends together while fitting these thwarts.

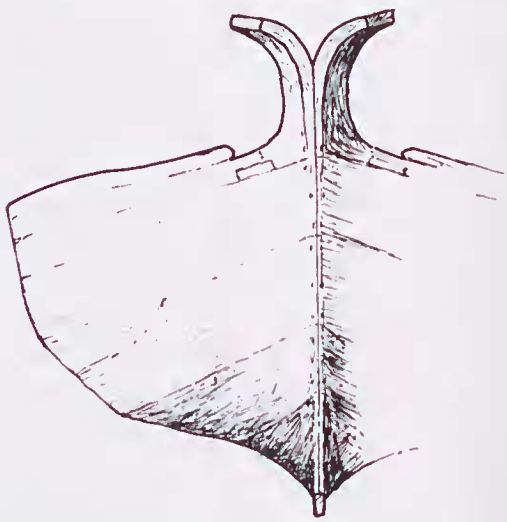


Fig. 16. Prow of a *perahu condong*, West Java.

Fig. 17. Profile of a *perahu compreng*, West Java.

The thwart in the stern is called *cengkal kemi* (*kemi* or *gemi* can mean stern and can also mean join or splice in nautical vocabularies of Indonesia).

Like *konteng* the *jong* are built entirely from good quality teak. Virtually all large *jong* are now fitted with small "long shaft" diesel motors which can be used for propulsion and to drive winches for handling nets. They also carry *lete* sails. Most *koteng* and *jong* have exuberantly colourful paint work which is executed in the yards where they are built.

Perawan*, a small *pedetan, is a vessel in the collections of the Northern Territory Museum. She is a very small example of a type that can be called *pedetan*, *bedetan* or *golekan* from Pasuruan in East Java

She was sailed to Australia in 1981 by a lone Dutchman, Thomas Johannes Meynen who died shortly after making an unfortunate landfall on uninhabited Grosse Island (12°35'S, 130°25'E). *Perawan* was later recovered by Northern Territory Museum staff, although some of her gear, including the rudder was missing. Double outriggers were fitted but they appeared to have been added for the voyage to Australia. They were very crudely fitted and showed signs of previously being fitted to a different type of vessel. The style of outrigger booms that were fitted to this vessel are found fitted to canoes at Pasir Putih in East Java (Horridge 1987:Fig. 7a) which are built at Pasisir near Besuki.

The midsection shows the four-straik construction (Fig. 7). There is one frame and two bulkheads which support thwarts. Aft there is a small bulkhead which has little structural significance because there are virtually no fastenings holding it in place. The keel is wide and shallow, midships it hardly projects below the garboard straik and it is made up of three pieces. The middle section is straight, the end pieces curve upwards and become narrower and deeper towards the ends. These pieces are scarfed on to the middle piece with long tenons (see Horridge 1979:12, 1987:73 for discussion of the symbolic significance of this type of structure). The stem and stern post are

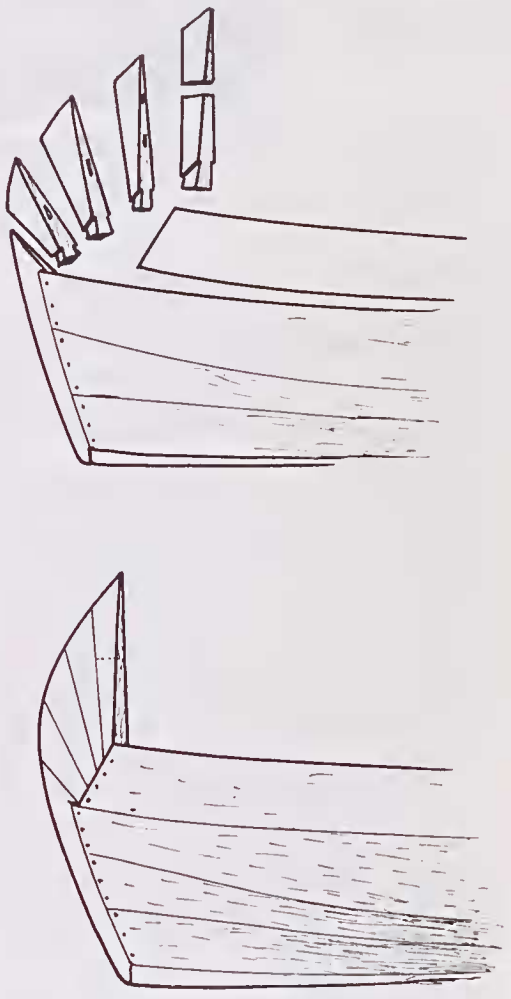


Fig. 18. Structure of a *perahu compreng* bow.

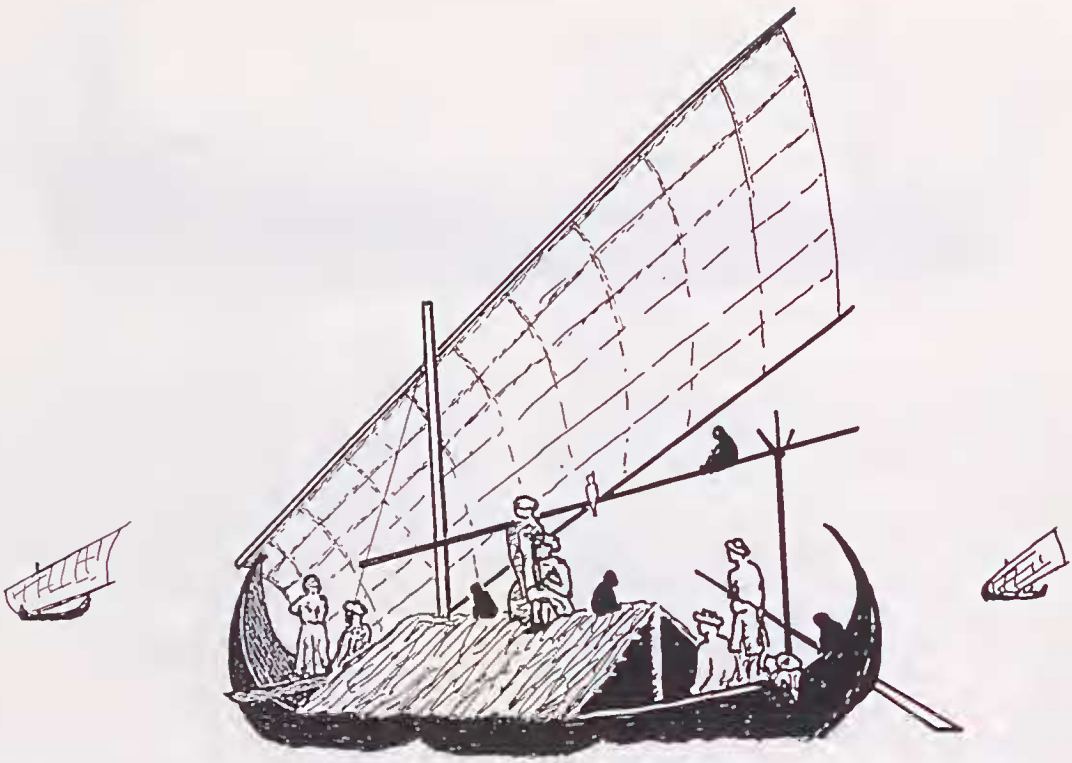


Fig. 19. *Perahu mayang*, circa 1830, redrawn by the author from a contemporary engraving by E. Duncan. There appears to be no stem or sternpost.

fitted onto the upper face of the keel extensions (Fig 7). There is no rabbett and no fastening of the top straik to the stem. The stem and stern post are effeetively only decorative finials on the projeeting upswept ends of the keel. The upper planking is held together in the bow by a thwart and in the stern by the short apron-like structure deseribed on the *perahu jong*.

Perawan is built of teak with mangrove (*Rhizophora* sp.) dowels. The edge-dowels are fitted with locking pins. The planks are fastened to the three frames with mild steel nails, most of whieh have rusted away. She had no leaking seams when she was recovered.

Semanis*, a small *lete is from the Madurese tradition (Fig. 29). *Semanis* is a fishing vessel from Munear, East Java, now in the eollection of the Northern Territory Museum. Although she was owned and operated from Muncar she was probably built on one of the Kangean islands east of Madura, or by builders from one of the islands east of Madura. On her registration papers she is deseribed as a *golekan*. Another *perahu* of the same type from Kangean, now in Darwin, is deseribed on her papers as *"Mayang Model Lete"*, whieh indicates a fishing vessel built in the *lete* style. *Lete* is the standard spelling of the name sometimes spelt *leti* (Horridge 1981, 1986; Hawkins 1982) and *leteh* (Gibson-Hill 1950).

Semanis does not have four-straik strueture or form, nor does she have bulkheads. There are six straiks forming a rounded bilge. There are thirteen frames, two are close together and bear the mast step. All the frames include floors. There are no half-frames. Some frames eonsist of single large timbers extending from rail to rail. Other frames include top futtocks fitted on one or both sides. Not all these top futtocks are original, some were fitted to replaee rotted ends of the original grown timbers by Mr Jamie Munro when he purehased *Semanis* in 1979.

The planking is eapped by a solid rail mueh like that on a *konteng* but it differs in that it is supported by the frames. Above the rail there are high wash straiks. These wash straiks were originally single planks of teak from bow to stern edge-dowelled to the rail. They contributed significantly to longitudinal strength. When they became rotted in Darwin *Semanis* became badly hogged (the bow and stern sagged). She has now been restored.

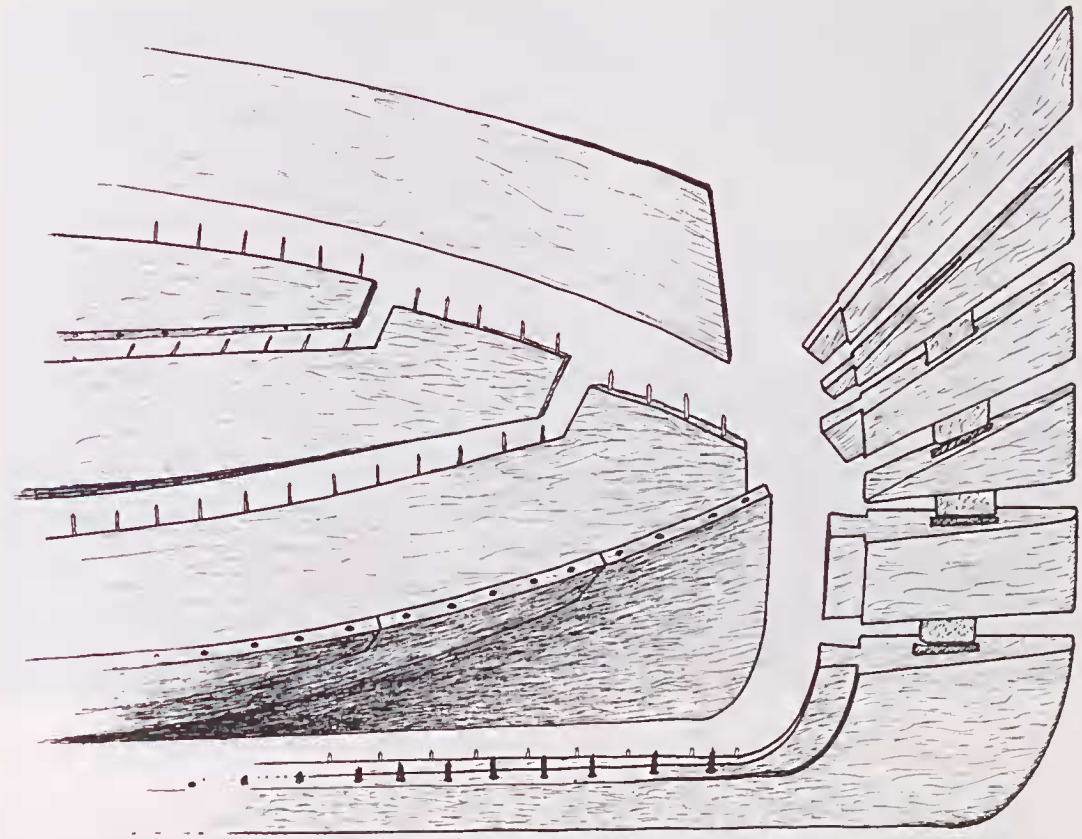


Fig. 20. Structure of *perahu compreng* stern.

The rails turn upwards to form large finials where they meet at the bow and stern. A short apron-like pieee is fitted between the eonvergent rails and the assembly is fastened together with dowels. This strueture holds together the upper straiks whieh are not fastened to the stem. The upper part of the stem is a separate bloek dowelled onto the stem; its funetion is decorative.

This strueture is standard for *perahu golekan* and *lete lete*. On the *perahu golekan* the rail finial structures are large while on modern *lete* they are small or even vestigial (see Horridge 1981: Pl. E, G, H, J, K). The *golekan* intended here is the vessel identified in Horridge (1981) but not the *golekan* in Hawkins (1982:64-66), whieh are more often ealled *kroman* or *janggolan*.

The mast on *Semanis* is stepped through a large thwart and wedged into the mast step in the same way as deseribed for *Terima Kasih* but the mast step is supported by two floors rather than sitting on the planking. The thwart is supported by stringers rather than a bulkhead.

The rudder is earried on the leeside as on the *mayang* but it is fitted into a noteh on the aft side of the large thwart mounted on the stern. In this respeet the rudder mounting is similar to the double rudder mounting system on traditional Sulawesi *perahu*. Javanese *perahu* (with the exeeption of the large cargo earriers of Sedayu Lawas) earry the rudder against the rail well aft of the major thwart in the stern. Madurese *golekan* and some other types earry their rudder lashed against the rail and the aft side of the thwart.

Semanis earried *lete* rig. She was sailed to Darwin in 1979 by Jamie and Miehael Munro. Another similar and slightly smaller *perahu* from Kangean was sailed to Darwin more reeently by Peter Walker and is still used as a yaeht. She has proved faster and slightly more weatherly than the *perahu lambo* in Darwin. Her hull is very shallow but the large rudder eonfers adequate resistanee to leeway and the *lete* rig is powerful.

Madurese perahu lis alis. These distinetive Madurese eraft range in size from eanoe size upwards. Larger sea-going, eargo-carrying

Fig. 21. Stern of *perahu compreng* under construction, the planking is in place and the aft frame or apron has been fitted but the sternpost is not yet fitted.

versions are called *kroman* and *janggolan* (Horridge 1981:32-34). They are distinguished by narrow transoms in the bow and stern and projecting ends of the keel (Fig. 30). In small *lis alis* the keel structure is similar to that in *Perawan*. The middle section of the keel is only a central plank; the size and shape of the projecting up-curving keel-ends suggest that there is a sturdy keel projecting below the hull, but this is not the case. The bottom of the transom is lightly tenoned into the keel-ends but it is held in place mainly by the planking which is fastened to it. Small *lis alis* often have four straiks but they are narrow and do not have the midsection of a *mayang*. They are similar to the *pencoan* in form and structure. There are few, if any ribs fitted in small *lis alis*, there are thwarts which stiffen the hull. Some of these thwarts are let through the planking.

DISCUSSION

The four-straik structure and hull form is found all along the Java coast where it is a strong prevalent tradition. Perhaps four-straik construction was more recently introduced to Madura where most *perahu* have a rounded turn to the bilge.

The four-straik structure imposes an upper size limit: to build a four-straik vessel substantially larger than a full-size *perahu konteng* would require planks of exceptional width. The design might derive from a sewn plank small boat tradition. There is a Southeast Asian sewn plank tradition which has an ingenious but very laborious system of sewing the planks together with stitches that are not visible on the outside of the plank seams (Manguin 1984). In the context of this particularly laborious technique there would be an obvious advantage in having only four straiks and therefore only four seams to stitch on each side of the hull. The reliance on the locked edge-dowels to hold the hull together, almost without frames as seen in small boats like *Perawan*, suggests a structural affinity with sewn plank canoes.

Sewn plank boats called *Masula*, which are built with four straiks, exist in Southern India (D. Dwyer pers. comm.). These vessels might be part of a related tradition although the sewing technique and the hull form are not the same as those of Southeast Asia.

The very large Javanese vessels of several hundred tons burthen encountered by early European navigators in Southeast Asian wa-

Fig. 22. *Perahu pencoan* from Waru, East Java.

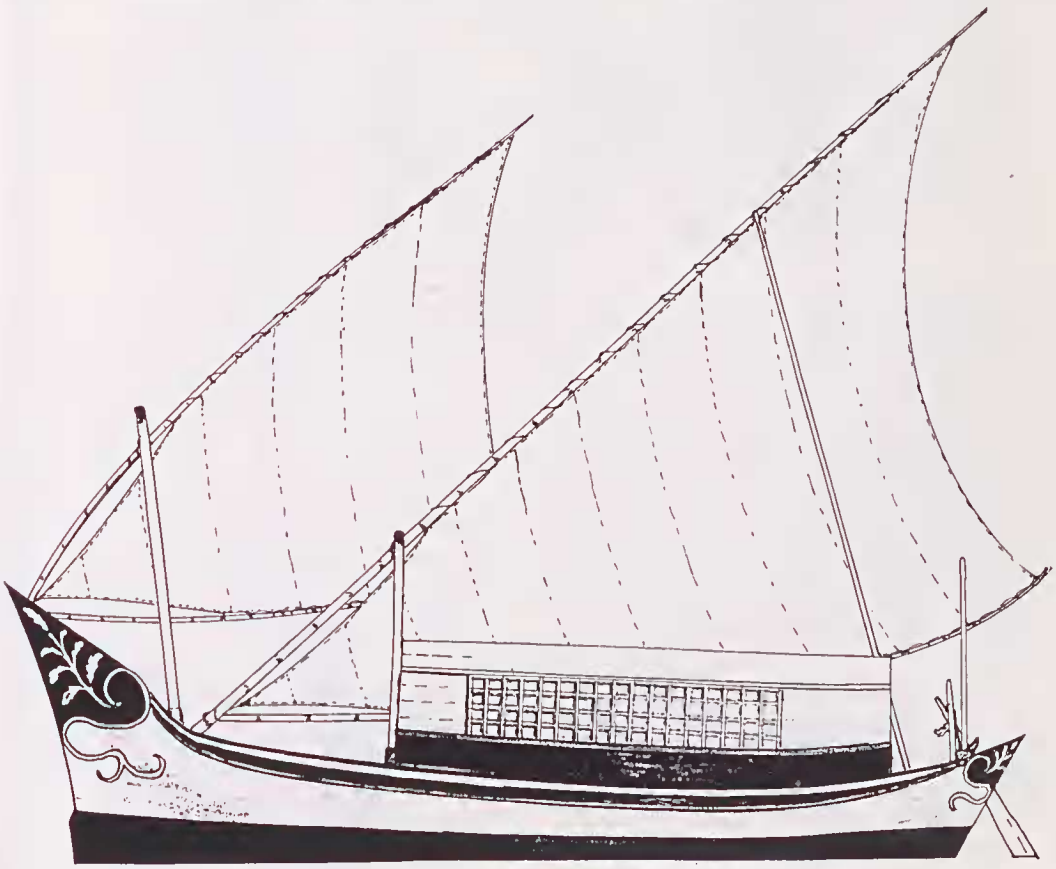


Fig. 23. Sketch of a large *perahu pencoan.*

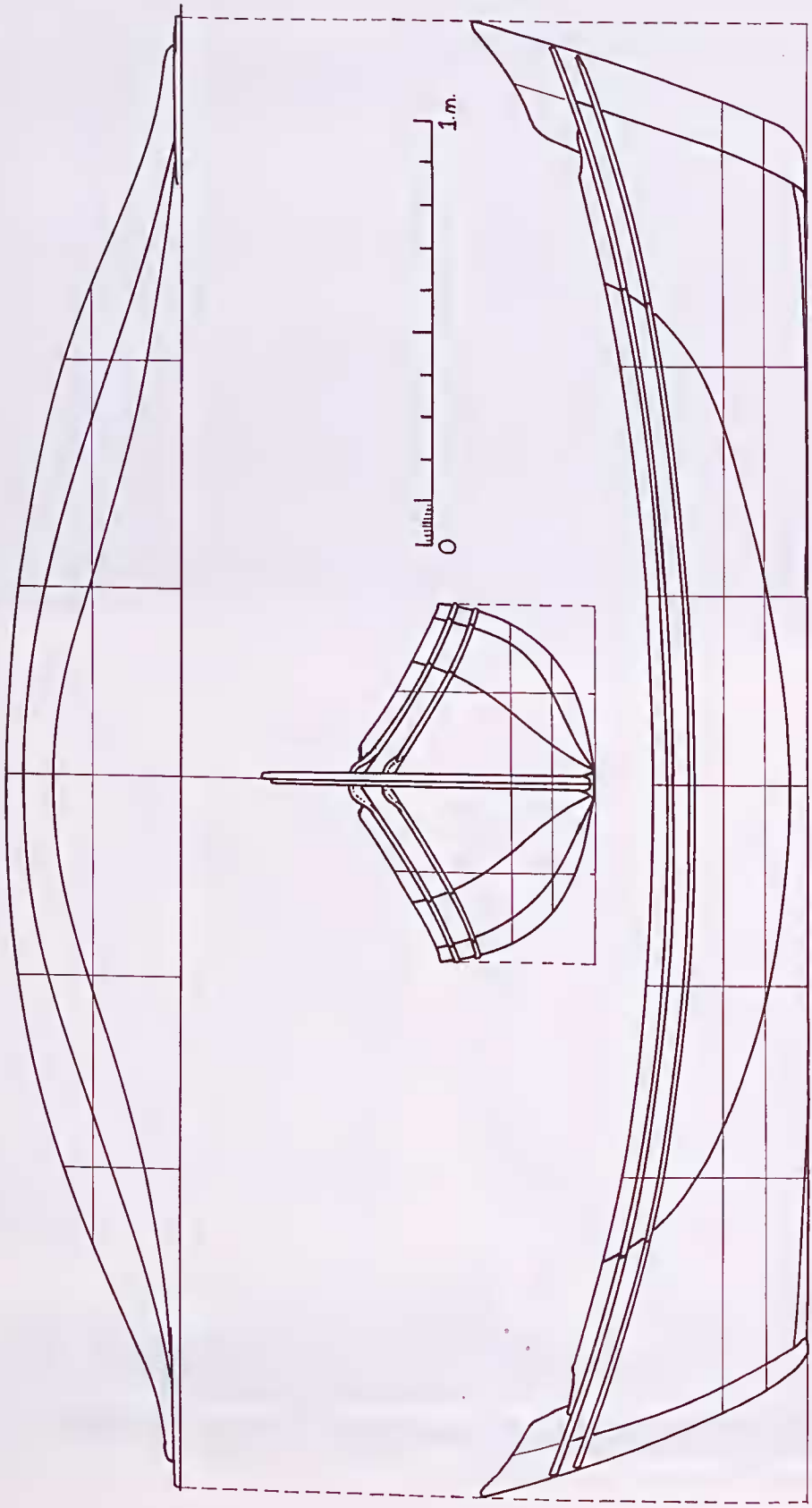


Fig. 24. Lines of a *sekoci* from Trengganu, Malaysia. The small *sekoci* is constructed with four straiks, the stem and stempost are fitted onto the ends of the planking and the keel does not project below the planking.

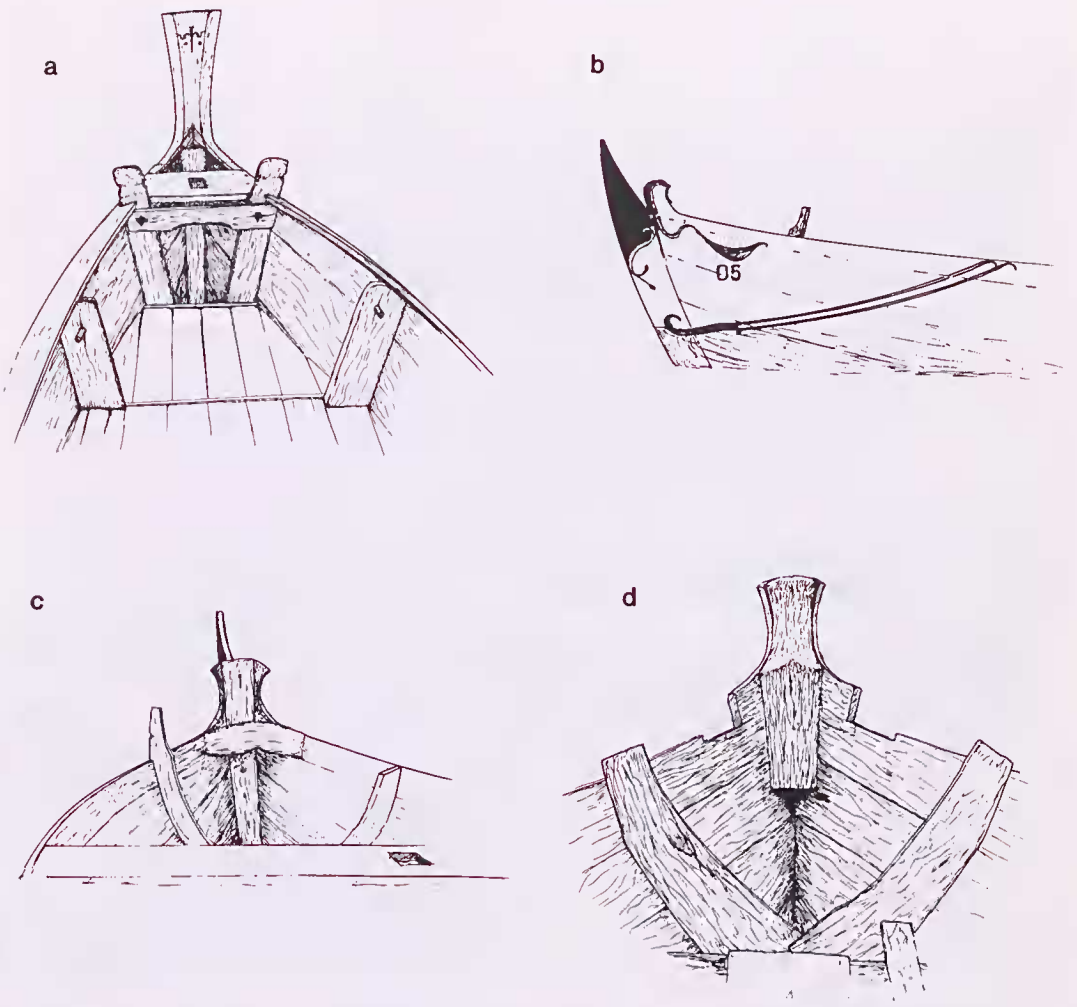


Fig. 25. **a.** Bow of a stemless *jegongan* showing forward frame, apron, forward thwart and prow finial with separate apron piece. **b.** Bow of large *sopek* from Central Java. **c.** Internal view of *sopek* bow showing the apron extended into the bow finial. **d.** Internal view of a *perahu ijon* bow showing the short apron piece extended into the bow finial.

ters, called *Jong* or *Jonque*, could not have had a four-straik structure (Manguin 1980). The *mayang's* construction and form were presumably archaic when the first Portugeuse vessel sailed into Southeast Asian waters. This conforms with Bowen's observation (1952:186) that "The sum total of the evidence in the Indian Ocean shows that fisherfolk cling most tenaciously to primitive forms of watercraft. Mariners, on the other hand, usually sail in craft that have been strongly influenced by foreign elements".

The rudder mounting system seen on Javanese *perahus* seems to be a design for small craft. It is a system which allows the rudder to be quickly unstropped and used as an oar although the rudder of a *perahu konteng* is too large to be easily handled in this way. Large Javanese *perahu* have almost disappeared, and the few that operate from Sedayu Lawas in East Java have a quite different rudder mounting system, even though some of the Sedayu Lawas *perahu* are actually large *konteng* planked up to more than twice their original moulded depth.

A standard *perahu konteng* such as *Terima Kasih* has two slightly projecting thwarts or beams in the stern which could be interpreted as vestigial quarter-rudder mounting beams. Another Javanese cargo carrying *perahu*, the *perahu kacik* of East Java (Horridge 1985:Pl. 2) also had (or have if any still exist) two

Fig. 26. Sketch profile of *perahu pekem*, Central Java.

Fig. 27. Cargo carrying *perahu konteng*, Sedayu Lawas, East Java.

projecting beams in the stern which could be interpreted as vestigial quarter-rudder mounting beams. They had no obvious function, but greatly resembled the rudder mounting beams of large Sulawesi *perahu*, except that the lower beam was slightly forward of the upper one on a *perahu kacik* whereas the lower beam is slightly aft of the upper one on a Sulawesi *perahu*. If quarter-rudders were mounted on beams positioned like those of a *perahu kacik* they would be secured against the aft side of the lower beam and the forward side of the upper beam (unlike the Sulawesi system which has the rudder against the aft side of both beams). Such a system might be more convenient with the long projecting rudder stock of the Javanese rudder.

The use of bulkheads rather than ribs is a feature of ancient Southeast Asian ships. Furthermore, the bulkheads were luted as if to make them watertight but had limbers to allow the passage of water in the bilge in ancient boat building (Green and Intakosai 1983:8), as in modern Javanese *mayang*. The number of bulkheads was most frequently twelve on the evidence of hulls discovered by maritime archaeology (Green and Harper 1987:2-4). In Indonesian boat building there is also a tradition of twelve frames, corresponding to the ribs of a human (Horridge 1979:13, 1981:57). The use of thirteen bulkheads in all *perahu konteng* and some other large *mayang*, and also the thirteen frames in *Semanis* seems to be a different tradition. Perhaps this reflects

Fig. 28. *Perahu ijon* from Blimbing, East Java.

Javanese preference for odd numbers which they believe to have magical powers.

The bow and stern structures vary regionally. There are completely stemless structures although most types have a stem timber. In most cases the stem does not have the same structural function as in western boat building, because the hood ends of the planks are not fitted into a rabbett on the sides of the stem. In some designs, especially of those of East Java and Madura, the ends of the keel turn upwards and the lower strake or strakes run out on the upturned keel ends, so these upturned ends function as a lower stem and stern post. On the *perahu lete* and similar types a complete stem sweeps up from the keel, but there is always a stemless structure for the upper strake or strakes, and the upper stem is mainly decorative. On *perahus* such as the *konteng* there is a full stem fitted on to the end of a straight keel, but the plank ends are edge-dowelled to the stem as they are to the upturned keel in other designs. In virtually all cases thwarts help tie together the two sides of the vessel in the ends. The stemless upper structures generally include an apron-like piece, but this is not identical to the apron in traditional western boat-building. The full length apron found in some Javanese *sopek* and the Trengganu *sekoci* (called *serang* in both places) could be an adaptation of a traditional structure and not entirely a copy of western boat-building.

Early European representations of Javanese *perahus* seem to show stemless vessels with profiles like that of the *kompreng*. Examples include a 1598 engraving in *D'Eerst Boeck* (reproduced in Manguin 1980:271), drawings by Sidney Parkinson, 1771 (reproduced in Joppien and Smith 1985:232, and redrawn in Horridge 1981:47), and most clear is a *mayang* in the foreground of an engraving by E. Dunean, from a W.J. Huggins painting of the ship *Sir David Scott* entering Sunda Strait February 1830 (redrawn here in Fig. 21).

The structure with the lower planking running out on a keel/lower stem but no upper stem could have been a feature of the larger merchant *jonques* of pre-colonial Southeast Asia.

A curious design affinity exists with some archaic *dhows*. Some of the sewn plank *dau* of Lamu, north of Zanzibar were apparently stemless above the first strake (MeGrail 1981: Pl. 31; Hornell 1941:Fig. 1a) and the *zarouk* of southern Arabia had a very raked stem and stern post which terminated just above the load water-line (Hawkins 1977:74). There are also smaller boats of sewn plank construction in south Arabia which are built with chines and have other features in common with

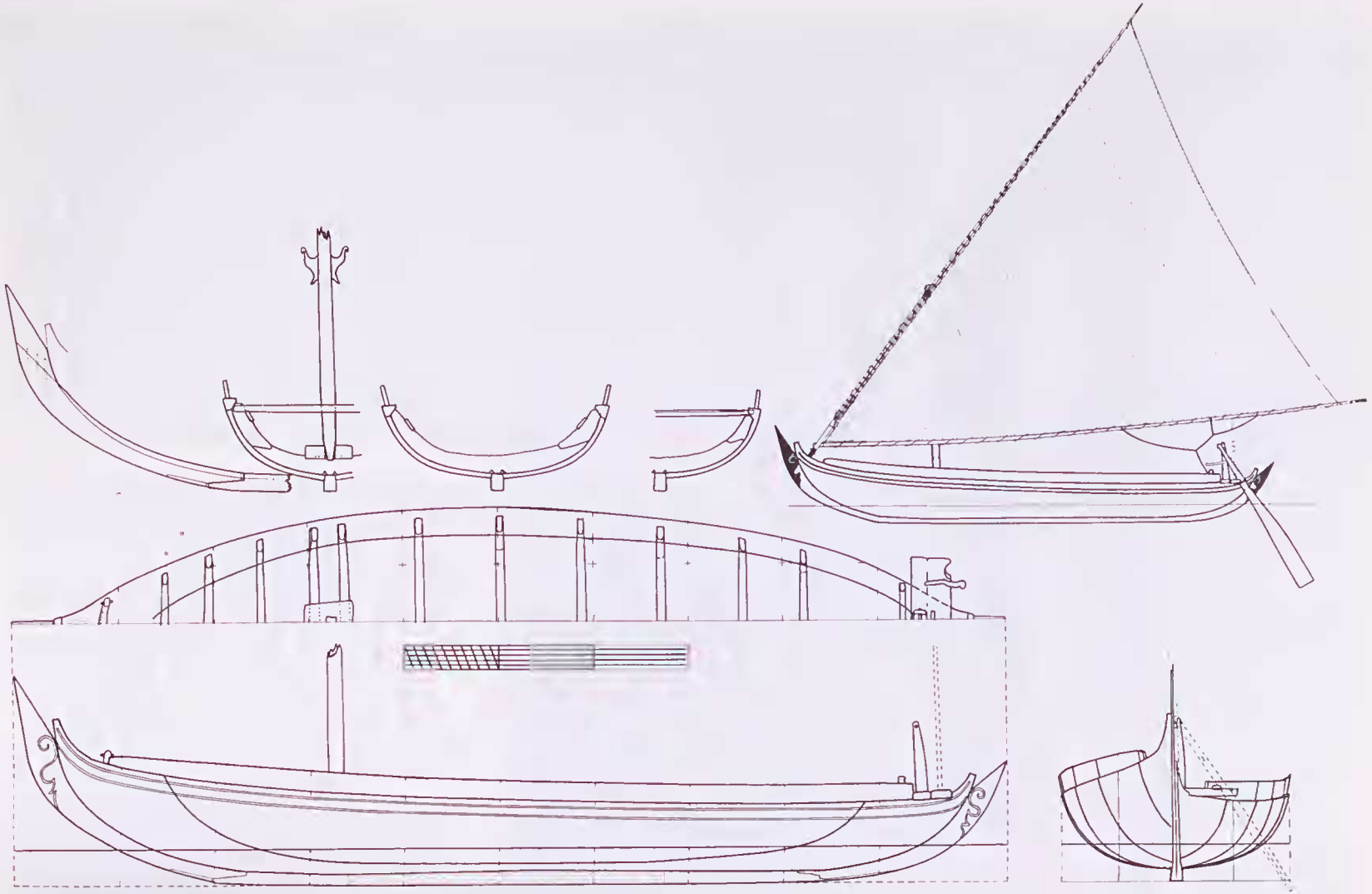


Fig. 29. *Semanis*, lines and construction.

Fig. 30. Bow of a small *lis alis*.

Javanesc *perahu*. The stem, keel and sternpost are succinctly described by Bowen (1952:210).

The stem and sternposts are straight members, roughly twice the thickness of thc planks, which comc togethcr at the bow and stern. The planks are not rabbettcd into the stem and sternpost, but simply butted against them. The keel is a flat mcmber which narrows at the bow and stern to the thickncss of the stem and sternposts.

This could be a description of a Javanese *perahu* or a Trengganu *sekoci* if slight curve of the stem and sternpost is allowed. The stem butted on to the end of thc planks is in fact necessarily a feature of sewn plank construction if any stem is used; it is not possible to sew the plank ends into a rabbett. The stem is thereforc of limited structural value; it helps hold the planking together and stiffens it vertically. A stem is not necessary in shell constructed vessels of little depth such as built up dugout or in larger vessels strongly built with thwarts, frames or bulkheads.

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